AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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At its annual meeting in December the American Association for the Advancement of Science commissioned a detailed operating plan for a study of the effects of the military use of herbicides on the land and people of Vietnam.

We are now attempting to formulate the specific objectives of the study. We hope to include both short and long range consequences within the broad areas of ecology, public health, and human welfare. The enclosures indicate the dimensions of the problem and suggest our preliminary thinking on the subject.

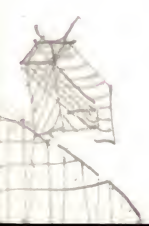
We ask for your help in this project. Specifically, we seek your advice on what specific questions the study should (and could) be designed to answer. Enclosed you will find a tentative list of questions for possible investigation. We would greatly appreciate receiving your suggestions for revisions and additions to this list. Suggestions on methodology would be welcome as well. We would also appreciate your suggestions of persons or organizations to whom we may turn for additional assistance.

Sincerely yours,

Matthew Meselson

Arthur H. Westing

Enclosures



MILITARY USE OF HERBICIDES

MAJOR CHEMICALS USED IN SOUTH VIETNAM

(U.S. Dept. of Defense Data)

Agent ORANGE: 2,4-D and 2,4,5-T

Composition: A 1:1 mixture of the n-butyl esters of 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid.
Active Ingredients: 4.1 and 4.4 lb./gal.
Application: Undiluted at 3 gal./acre. Often applied a second time.
Major use: Against forest vegetation.

Agent WHITE: 2,4-D and Picloram

Composition: A 4:1 mixture of the tri-iso-propanolamine salts of 2,4-D and 4-amino-3,5,6-trichloro-picolinic acid in water. (Picloram is the same as Dow Co. "Tordon"; the mixture used is the same as Dow Co. "Tordon-101.")
Active Ingredients: 2.0 and 0.54 lb./gal.
Application: Undiluted at 3 gal./acre.
Major use: Same as for agent Orange.

Agent BLUE: Cacodylic Acid

Composition: A 6:1 mixture of sodium dimethyl arsenate and dimethyl arsenic acid in water. (Cacodylic acid is the same as Ansul Co. "Phytar-560G".)
Active Ingredients: 3.1 lb./gal.
Application: Undiluted at 3 gal./acre.
Major Use: Against rice and other food crops.

MILITARY USE OF HERBICIDES

APPROXIMATE EXTENT OF SPRAYING IN SOUTH VIETNAM

(U.S. Dept. of Defense Data)

Year	Forest Land	Crop Land	Total Land
1962	4,900 acres	700 acres	5,600 acres
1963	24,700	200	24,900
1964	83,500	10,400	93,900
1965	155,600	65,900	221,500
1966	741,200	104,000	845,200
1967	1,486,400	221,300	1,707,700
1968	1,267,100	63,700	1,330,800
1969 (First half)	797,200	38,800	836,000
TOTAL	4,560,600 acres	505,000 acres	5,065,600 acres

Note:

The total area of South Vietnam is approximately 42 million acres. Of this, about 7.6 million acres is under intensive cultivation and about 14 million acres is forested (89% semi-deciduous, 9% mangrove, and 2% conifer).

MILITARY USE OF HERBICIDES

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MILITARY USE OF HERBICIDES

THE QUESTIONS

I. The Herbicides

A. Usage of Herbicides

1. What are the major chemicals that have been used? Where have they been used? At what times? At what dosages? How many repetitions? In what total quantities?

2. To what extent have herbicides affected regions not intended to be sprayed? By flight errors and accidents? By drift? By volatilization? By transport in water?

3. What is the purity of the chemicals used? What are the levels of possibly significant contaminants? How has this varied in each major lot?

4. What findings and what claims are already available regarding effects of herbicides in South Vietnam (or in relevant situations elsewhere)?

5. Are there countermeasures or antidotes that can be applied to ameliorate any adverse effects of the chemicals used? Are any being used?

B. Fate of Herbicides after Application

6. At what rates and by what processes do herbicides disappear from the soil in the different habitat types in which they are used? from the water? from living organisms? What is the situation in areas sprayed once or more than once?

7. What are the specific chemical and biochemical pathways of herbicide decomposition? Do these differ in the different habitat types involved?

8. What important abnormal metabolites or abnormal metabolite levels does herbicide application induce in living organisms?

9. Does the burning of wood or leaves from herbicide treated vegetation produce any significantly harmful products?

10. What levels of herbicides, herbicide breakdown products, and herbicide induced substances are ingested by various human population groups?

II. Ecology

A. Baseline Data

1. What are the major natural vegetational types (communities) in South Vietnam, and what is their species composition? How are the types distributed, and what is their extent?

2. At approximately what successional stage is each type? What are the presumed successional states for each type?

3. What is the composition of the animal communities that accompany each of the vegetational types?

4. What are the major soil types and their distribution?

5. What are the climatological conditions?

B. Effects of Herbicide Usage

6. What plant and animal species are particularly sensitive to the different herbicides (or contaminants or break-down products)? Why?

7. How do the several plant communities change following one spraying? Several sprayings?

8. How do the associated animal communities change?

9. How do the soil macro- and micro-organisms change?

10. How have the aquatic habitats (as well as the edible fish, etc.) been affected?

11. Are any of the soil types affected? In texture or structure? In organic-matter content of the litter layer or below? In nutrient availability? Has significant erosion or laterization resulted? Are there changes in the water table?

12. What are the important specific effects on the plants and animals exposed to the herbicides? Are there significant effects on health? growth? development? fecundity? chromosomes?

13. Are there significant ecological interactions between herbicide effects and bomb craters, bulldozing, fire, etc.?

III. Health (Public and Individual)

A. Baseline Data

1. What was the population distribution in South Vietnam before 1960? For each year since?

2. Are there other basic demographic data available for these years on a region by region basis?

3. Are there detailed public health data available for each of the years and regions of interest?

4. Are there disease vector data available (population sizes and distributions)?

5. What have been the public health measures routinely employed for the years and in the regions of interest?

6. Where are the major hospitals in South Vietnam and by whom are they operated?

B. Effects of Herbicide Usage

Note: The following questions apply to the herbicides themselves as well as to their contaminants and breakdown products, and to deleterious induced metabolites possibly produced in food organisms subjected to spraying.

7. Are there significant immediate (or acute) threats to human health from direct contact with or ingestion of the chemicals involved? What proportion of the population is particularly (or abnormally) susceptible or allergic to each of the chemicals involved?

8. Are there significant long-range (or chronic) threats to humans? Toxicity? Teratogenesis? Carcinogenesis? Mutagenesis?

9. What is the extent and seriousness of malnutrition that can be attributed to herbicide usage?

10. Are any of the possible health problems related in severity to age, sex, previous medical history, or other factors?

IV. Human Welfare (Social and Economic)

A. Baseline Data

1. What are the living standards of rural South Vietnamese in unsprayed regions in the various parts of South Vietnam (or in affected areas, prior to spraying)?

2. What is the structure of the rural local economy in unsprayed regions in the various parts of South Vietnam (or in affected areas, prior to spraying)?

Note: See also questions III.1 and 2.

B. Effects of Herbicide Usage

3. What is the economic impact on local populations of one spraying? of several sprayings? What is the impact on individuals; on the village economy; on local markets?

4. How (and how permanently) are garden crops affected? Tree fruits? Livestock?

5. How (and how permanently) are orchards and plantations affected? Rubber; coffee; tea; tapok; teak; etc.?

6. How (and how permanently) is fishing affected?

7. How (and how permanently) is forestry affected? For timber; pulp; charcoal; game; etc.?

8. What is the psychological impact of herbicide usage?

9. To what extent does herbicide usage contribute to population migration? What proportion of this migration is permanent? What are the resulting urban and other social effects?

10. Are there beneficial effects from spraying?

11. Are there ameliorative measures that should be (and can be) instituted to mitigate herbicidal damage? At the time of spraying? Afterwards?

V. Procedures and Priorities

1. Of all the questions listed, which are of highest priority?

2. Are there additional important questions which have been overlooked?

3. Which of the questions are likely to be answerable in one year? two years? five years?

4. What would be the optimal staffing, equipment, and facility requirements in the answering of these questions? What would be the minimal requirements?

5. Whose cooperation must or should be sought in attempting to answer these questions?